MFM Tapping Mode Instructional Guide

STEP 1: LOG IN TO THE AFM LOG BOOK

"NOTE: this guide does not take the place of reading the manual"

Figure 1
AFM Stage & Head assembly

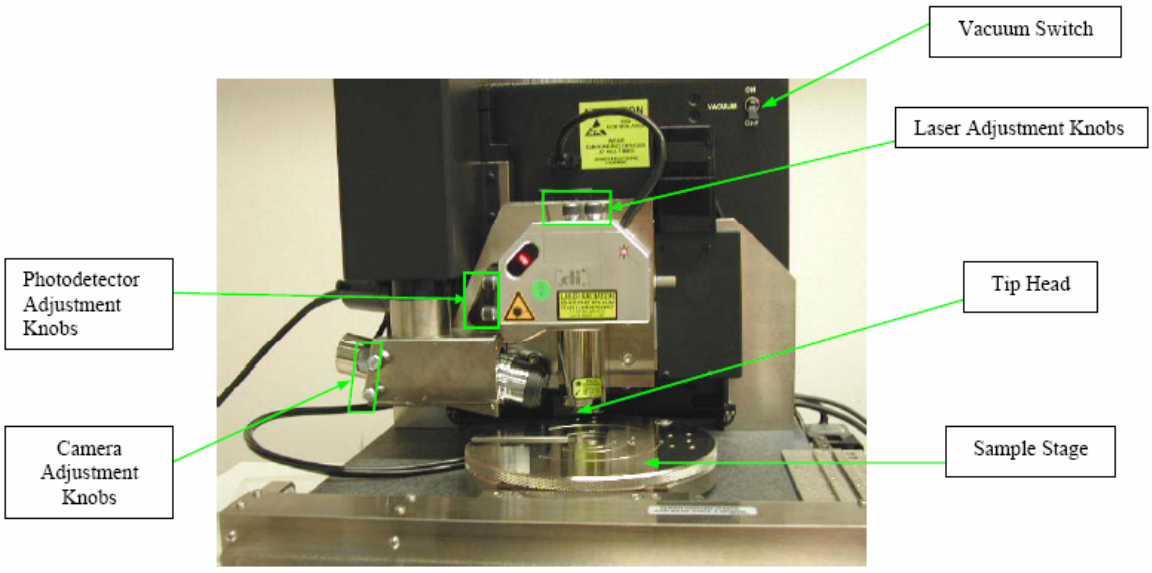
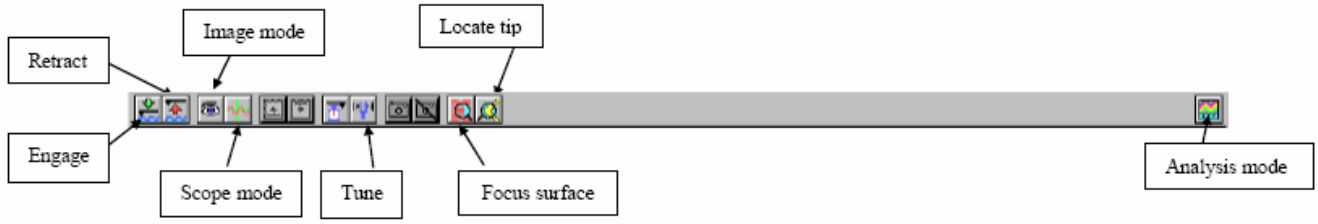


Figure 2
Software Toolbar



Part 1: Start-up

1. Turn on the system by switching on the power strip behind the monitors.
2. When the log-in screen appears, just press OK. There is no password.
3. Open up the MFM software with the "Nanoscope SPM" shortcut icon on the desktop.
4. Click on the  (microscope) icon to go to the main display.
5. Make sure the microscope is in MFM Mode by selecting 'Profile' from the 'Microscope' menu.
6. In all **Channel** panels, the **Highpass** and **Lowpass** filters should be set to **Off**.
7. The **Rounding** parameter in the **Microscope/ Calibrate/ Scanner** window should be zero.

Part 2: Magnetizing the Probe

1. Once the microscope is in MFM mode, the software must be restarted. Select **DI/exit** to shut down the software.
2. While the software is shut down, prepare the MFM probe as follows:
    a. Place an MESP magnetic tip in a standard cantilever.
    b. Magnetize the probe by placing it in the dimension magnet holder for several seconds before mounting it on the tip head (figure 3).
3. Once the probe is mounted, restart the software. It should restart into MFM mode. Double check the highpass and lowpass filter and the rounding parameter settings before continuing.
4. Align the laser following the same procedure used for AFM. The sum should equal about 3.5

Figure 3 Magnetizing the probe

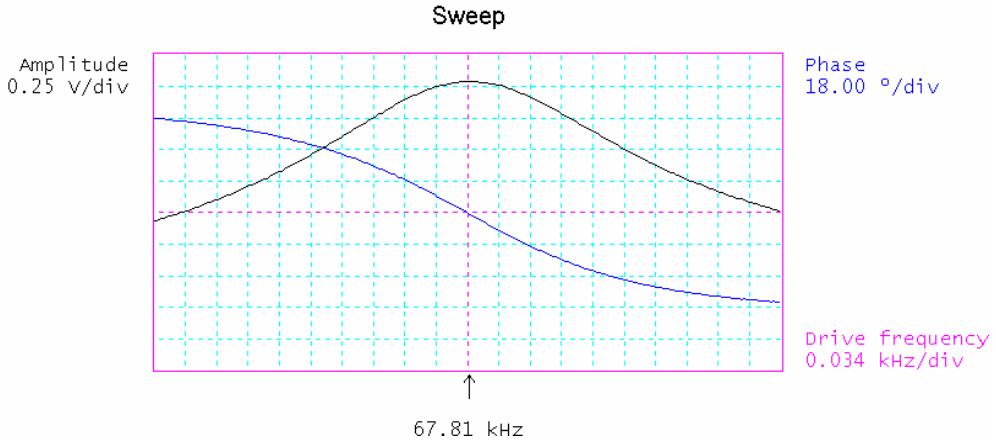
Figure 4 Magnetic Sample Holder

Part 3: Cantilever Preparation

1. Place the magnetic sample holder (figure 4) with your sample on the microscope stage and align the sample under the green illuminator. Be aware of the extra height due to the magnetic sample holder and take care not to contact the cantilever with your sample.
2. Click on the  icon (or select 'locate tip' from the 'stage' menu) to locate the tip. Use the camera adjustment knobs to center the tip on the screen, and use the focus function on the trackball to focus the tip.
3. Click on the  (focus surface) icon once again and use the trackball to focus the sample underneath the tip and to locate the specific area you want to scan. Never use 'Autofocus'. It does not work correctly.

Part 4: Scanning

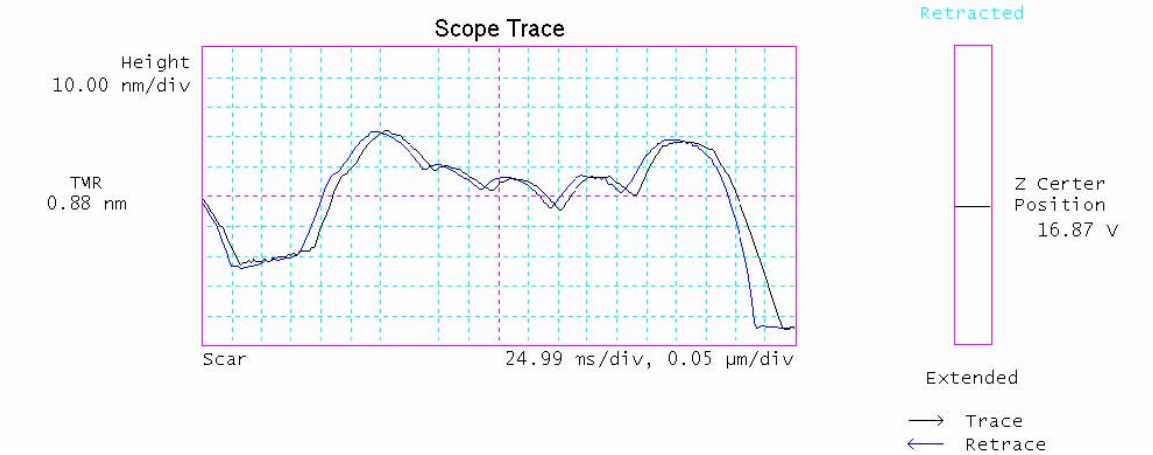
1. Before lowering the tip and starting a scan, you must tune the cantilever by clicking the  (tune cantilever) icon. Click on the 'Autotune' button (upper left side of screen). When the computer is finished tuning the cantilever, the picture you see should look close to Figure 6. If it doesn't, ask for assistance. When you are done, press the 'Back to Image Mode' button.



2. Set the initial scan parameters. Under **Interleave Controls** set the **Lift Start Height** to **0 nm**, and **Lift Scan Height** to **100 nm.** Under **Scan Controls**, set the **Scan Size** to **5 μm** and **Scan Rate** to **1-2 Hz**. For the left image, set the **Z range** to **75 nm** and the **line direction** to **Retrace**.

3. Lower the tip by pressing the (engage) icon. Click yes when prompted to continue in Interleave mode. The computer will then automatically start a scan.

4. When the tip starts scanning, go to scope mode by pressing the (scope) icon. To get a valid image with MFM, the 'trace' and 'retrace' lines on the scanning mode graph must match up with each other. There are several parameters that can be changed to make this happen (see figures 7 and 8 below). To go back to image mode to view your scan, press the icon.



Be careful when adjusting the amplitude setpoint. Make sure you keep this line nearly centered. If it gets too high, you won't see details of the sample. If it gets too low, you might crash the tip-which will cause it to break! These two lines should track each other well (i.e., look similar)

5. To capture an image, press either the (down) icon to restart a clean scan from the top, or the (up) icon to start it from the bottom. Then press the (camera) icon to start capturing an image. You'll notice that at the bottom of the left computer screen, the words 'Capture: On' will be displayed. When the computer finishes capturing, the words will say 'Capture: Done'. The captured image will automatically save. If you decide you don't want to capture, click the (cancel capture) icon. When the capture has finished, you can withdraw the tip by pressing the (retract) icon.

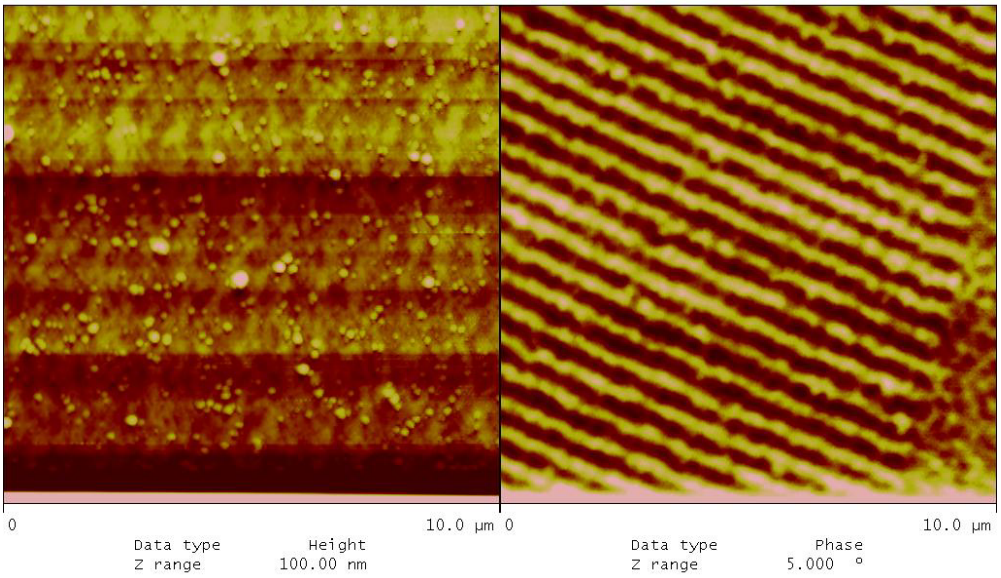


Figure 5 Magnetic tape

Part 5: Image Analysis

1. After you have captured the image, you can view your saved image and do analysis by pressing the icon. This may take a couple of seconds. To name your file, go to File/Rename. If you want to export your file to a disk or another drive, go to Utilities/JPEG Export. Save the image in reverse colors and give it the name you want.

2. **For the full explanation of all of the functions in the MFM software, please see the users manual.** Here are a few things you can do with your Nanoscope Image file:
   a. If you want to see your image in 3D mode, press the icon
   b. If you want to see your image flat, press the icon
   c. To analyze roughness, press the icon.

   There are many more functions listed in the 'Analyze' menu at the top of the screen. **For full descriptions, see the manual.**

3. If at any time you wish to save the current analysis of your image, go to Utilities> JPEG Export.
4. If you wish to print the current analysis screen, press the icon.

Part 5: Shutdown

1. When you are finished analyzing your data and have saved all the files you want to keep, go back to the microscope mode by pressing the in the top right corner. Then press the (focus surface) icon and raise the head to back the tip away from the sample stage. Turn the vacuum off then rotate the sample stage and remove the sample. Make sure to remember to turn off the vacuum switch before attempting to remove the sample.
2. Exit out of the Nanoscope software by going to DI/exit.
3. Shut down the computer using the Windows shutdown. When the computer says it is safe to turn of the computer, turn off the power strip in the back.

FINAL STEP: LOG OUT OF THE AFM LOGBOOK